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OBSERVATIONS  
ON THE  
GANGLIONIC ENLARGEMENT  
OF THE  
PNEUMO-GASTRIC NERVE;

THE PROBABLE FUNCTION OF THAT GANGLION;  
AND THE POSITION WHICH IT OCCUPIES IN THE HUMAN SUBJECT  
AND IN SEVERAL OF THE LOWER ANIMALS.

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I HAVE been induced to draw up the details of this Paper in consequence of a communication received a short time ago from Sir Astley Cooper. It will be seen that I have attempted nothing more than to follow out his views on the subject, and to enlarge somewhat on a discovery which is exclusively his own; and which will be best understood by quoting his words, as addressed to me in the following letter, which was accompanied by a preparation.

“ MY DEAR EDWARD,

“ April 18, 1837.

“ I have sent you the *superior laryngeal ganglion* of a rabbit, which I found last year (February 1836), whilst making the experiments I have published in the Guy's Hospital Reports on the Compression of the Carotid and Vertebral Arteries. I always thought it an objection to my friend Sir Charles Bell's opinion of the ganglia giving sensibility, that the laryngeal nerve, going as it does to parts of the most sensitive description, was not ganglionic. It gave me much pleasure to find this ganglion. If you put the nerve in water for five minutes, you will see the usual colour of a ganglion in the enlarged part from which the laryngeal nerve springs.

“ Yours affectionately,

“ ASTLEY COOPER.”

In almost every work on descriptive human anatomy, mention is made of the peculiar appearance presented by the pneumo-gastric nerve, and of the slight enlargement which it experiences at the external base of the scull, just as it is leaving the foramen lacerum. This enlargement is variously, but at the same time very slightly, alluded to by different anatomists. Many have noticed the rounded, bulbous, and plexiform appearance of the nerve at that part, likewise its grey colour: some speak of it as a condensation and thickening of the nervous fibres, in which the surrounding cellular tissue is much implicated: others seem to consider it as the point where the connexion takes place between the pneumo-gastric and the surrounding nerves. It has been called a ganglionic enlargement, but without any peculiar meaning being attached to the term. No one appears to have particularly examined or described the precise anatomical nature and appearance of this ganglion, or to have assigned to it any peculiar physiological function. I am not aware that any attempt has been made to prove that it is either a ganglion *sui generis*, or that it bears an analogy to the ganglia of other nerves\*. The difficulty of exposing the nerves as they issue from the foramen lacerum—of disentangling and extricating their filaments from the sheath and the surrounding cellular tissue in which they are involved; the uncertainty which exists with regard to the precise origin of the par vagum—how far it may be considered as belonging to a separate system, and how far it possesses functions, in common with the spinal nerves, of motion and sensation; perhaps, in some measure, account for the little notice which appears to have been taken of the ganglionic enlargement in question. That a peculiarity does exist in the texture of the nerve at that part, seems to be generally admitted; but the explanation of this peculiarity seems to have been purposely slurred over, or altogether omitted, by the anatomist and physiologist.

The pneumo-gastric is now usually considered to form

\* It is but justice towards an anatomist who, for indefatigable research and fidelity of description, stands unrivalled, to observe, that Meckel, in his Descriptive Anatomy, has given a very accurate account of the ganglion in the human subject.



part of a separate class of nerves presiding over the functions of respiration, deglutition, and digestion; and the origin of this set, or the centre of their nervous influence, has been referred to the cineritious matter of the olivary bodies\*. If, however, we examine the distribution of the par vagum, it will surely be admitted that some portion of the nerve exercises a function of voluntary motion and common sensation, precisely analogous to that of the spinal nerves. I more particularly allude to those branches which supply the larynx; viz. the superior and recurrent laryngeal. The latter of these is principally distributed to the muscles of the larynx, and is therefore a nerve of motion; while the former, although it furnishes some slender muscular filaments, is almost entirely devoted to the mucous membrane, covering the epiglottis and lining the sides of the cavity: it is therefore a nerve of sensation†. Let us now direct our attention to the origin of the par vagum, or rather to the spot where it leaves the surface of the medulla oblongata; and we shall find, that the nervous fibrillæ which compose it come off in close apposition; on the one hand, with the corpora restiformia, or common sensory columns of the spinal cord; and on the other, with those fibres of the corpora pyramidalia, or anterior motor columns, which Mr. Solly has traced, and described, as passing into the cerebellum: so that, besides the origin which the pneumo-

\* It is not my intention to raise objections on either of these points; although the respiratory system, as laid down by Sir Charles Bell, involves many physiological discrepancies; while, on the other hand, the centre or origin of the nerves of respiration still continues to be a subject for speculation and inquiry. Nevertheless, the classification may be received as a judicious and useful arrangement; and the anatomy, which refers the origin of the par vagum to the corpora olivaria, is probably correct with regard to the greater portion of the nerve.

† The distribution of the laryngeal nerves is, I believe, incorrectly given in all anatomical works. My colleague, Mr. Hilton, has lately taken much pains in the investigation of this subject; and the result of his dissections shew that the superior laryngeal nerve (after it has pierced the thyro-hyoideal ligament) gives off no muscular filaments whatever, but is entirely distributed to the mucous membrane. The crico-thyroideus is, therefore, the only laryngeal muscle supplied by it in the human subject; and in some animals, the crico-thyroidean twig will be found to arise, not from the superior laryngeal, but from the trunk of the pneumo-gastric itself. All the proper muscles of the larynx, with the exception of that just mentioned, receive their nerves from the recurrent branch alone.

gastric is supposed to derive from the olivary bodies, comprising, no doubt, the greater portion of the nerve, and constituting its specific character, it likewise possesses every facility of position for deriving fibres from the anterior and posterior columns, or the motor and sensory tracks of the medulla spinalis. It may, perhaps, admit of some dispute, whether the laryngeal muscles, and the recurrent nerve supplying them, are to be considered as voluntary, in the strictest sense of the term; and their action may possibly be modified by the influence of the sympathetic: but the nature and function of the superior laryngeal nerve can hardly be mistaken. The exquisite sensibility of the mucous membrane at the entrance of the larynx at once stamps the character of the nervous filaments which supply it: we recognise them as nerves of common sensation, performing a duty similar to that exercised by the twigs of the fifth pair supplying the conjunctiva, the membrane of the nose, the external auditory passage and membrana tympani; all of which, as well indeed as the cutaneous nerves distributed over the whole surface of the body, derive their origin from the same medullary track, and belong to the same class as regards their function. They constitute the safeguards—the sentinels to the animal frame, the intelligencers of approaching mischief; and they severally impart a degree of sensibility, more or less exquisite, in proportion to the importance of the organ over which they keep watch, and its liability to external injury.

We may, therefore, consider the superior laryngeal branch of the par vagum as a nerve of common sensation; and we may fairly infer, that, with the exception of the few muscular filaments it contains, it is derived from the sensory column of the spinal cord; in fact, that it is analogous to the posterior roots of the spinal nerves; and that the ganglion which forms the subject of this paper is the ganglion belonging and appended to the sensory portion of the par vagum, or, in other words, as Sir Astley has described it, “the ganglion of the superior laryngeal branch\*.”

\* This expression appears to me to require a little modification, or rather explanation. The name by which Sir Astley has designated the ganglion is at once correct and judicious, inasmuch as the laryngeal branch is derived from the ganglion itself; but at the same time it seems to be too exclusive



The dissections which I have made on various animals all tend to confirm the accuracy of the opinion entertained by Sir Astley Cooper respecting the nature and function of this ganglion; viz. that it forms one of that class of ganglia which appear to be necessary appendages to all nerves of common sensation; and that it belongs more particularly to the superior laryngeal nerve, which indeed is the only branch of the par vagum which we can positively identify as exercising a purely sensitive function†. The

exclusive in its signification, as restricting the use of the ganglion to that nerve alone: whereas, from the dissections I have made, I have every reason to believe that the ganglion does not belong exclusively to the laryngeal branch, but extends its influence to numerous other filaments included in the trunk of the par vagum, and affording to the lungs, to the pharynx, œsophagus, and stomach, that faint but peculiar sensibility which they appear to possess—filaments which impart to the stomach the sensation of fulness when that organ has been distended with food; to the lungs, the “besoin de respirer,” and the sensory functions necessary for respiration alluded to by Bichat. In the sheep, where I was enabled to unravel the fibres of which the par vagum is composed, and trace with considerable accuracy their course and their connexion with the ganglion, I found the following arrangements to exist:—The pneumo-gastric trunk, as it left the base of the scull, might be said to consist of two orders or sets of filaments; viz. the ganglionic, and the ganglionless. The former terminated in the ganglion, where their fibrous character became lost after the manner of the posterior roots of the spinal nerves: the latter were continued downwards beyond the ganglion, having merely a cellular connexion with it, and resembled in this respect the motor portion of the fifth pair. Lastly, from the ganglion arose two sets of nerves: the one constituted the laryngeal; the other joined the ganglionless filaments mentioned above, and formed part of the trunk of the par vagum, descending to the chest. A careful dissection will bring to light a similar arrangement in the human subject, the horse, the ass, and probably in other animals. (*Vide* Diagrams 5, 6, 7.) I may also observe, that the laryngeal nerve appeared to derive some very minute fibrillæ from the pneumo-gastric trunk above the ganglion. These might be either specific respiratory filaments, or motor-muscular filaments, perhaps both.

† The resemblance between the ganglia on the posterior roots of the spinal nerves and the pneumo-gastric ganglion did not escape the observation of Meckel. He seems, indeed, to have considered the pneumo-gastric, glosso-pharyngeal, and accessory nerves as all derived from the posterior spinal columns; and thus constituting a posterior root, which, on its exit from the cranium, is joined by the lingual nerve from the anterior columns;—the combination of the four nerves thus forming a trunk, which, in its origin, composition, and function, is analogous to a spinal nerve. This view of the subject can, I think, hardly be maintained; as it is much more in accordance

first of these positions is supported by the circumstance, that this ganglion, both in colour and texture, exactly resembles those on the posterior roots of the spinal nerves: the latter position is proved by the fact, that in the larger animals, where the tissues admit of a more easy and accurate examination, the laryngeal branch may be seen to come off distinctly from the ganglion, and that the position of the latter varies according to the origin of the nerve. Thus, in the human subject, the ganglion is situated immediately at the base of the scull; and it is there that the laryngeal nerve is sent off. In the rabbit, the ganglion, and consequently the point where the laryngeal branch is detached from the pneumo-gastric trunk, will be found much lower down, or nearly in a line with the upper edge of the thyroid cartilage. In the dog, the ganglion is placed close to the lacerated opening, whence the laryngeal nerve descends very obliquely: in the ass, the latter is given off below the level of the larynx, and ascends to pierce the thyroid cartilage.

The shape of the ganglion presents great varieties in different animals. In the dog, cat, rabbit, and rat, it is rounded and bulbous, projects considerably from the pneumo-gastric trunk, and is immediately recognised on laying bare the nerve.

In the human subject, in the horse, the ass, and the sheep, it is more or less elongated or spindle-shaped; and is in great measure concealed by nervous fibrillæ, which pass over its surface without being connected to it; and which must be turned to one side, before the body can be distinctly brought into view. Generally speaking, the length of the ganglion will be found to bear a certain proportion to the length of the neck of the animal; and the varieties of shape and position which it assumes in different animals has probably no other object than to adapt it more conveniently to the surrounding parts.

accordance both with anatomy and physiology to suppose that the three first nerves contain motor as well as sentient fibres.

Mr. Solly, in his work on the Brain, has expressed himself in favour of this latter opinion.



In the Plate which accompanies this paper will be found diagrams of the more remarkable diversities of form which the ganglion presents in different animals. In some of the examples, the fibrillæ of the pneumo-gastric trunk have been unravelled, and separated, to exhibit the partial connexion of the ganglion with the nerve.

As far as my observations have carried me, the glosso-pharyngeal nerve appears to be furnished with a ganglion, in all respects similar to that which has formed the subject of this paper.

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### EXPLANATION OF THE PLATE.

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*Fig. 1.* represents the pneumo-gastric nerves of the rabbit, with the ganglionic enlargement and the superior laryngeal nerve of either side, arising from the ganglion, and passing to the larynx.

*Fig. 2.*—The same in the ferret.

*Fig. 3.*—The same in the guinea-pig.

*Fig. 4.*—Pneumo-gastric trunk of the dog, with the ganglion and superior laryngeal branch.

In the three next diagrams, the fibres of the pneumo-gastric trunk have been separated from each other, in order to illustrate their partial connexion with the ganglion.

*Fig. 5.*—Diagram of the pneumo-gastric nerve in the human subject:—

- a* The fibrillæ by which the nerve arises from the respiratory track.
- b* The plexiform appearance produced by the interlacement of these fibrillæ as the nerve is leaving the foramen lacerum; being the spot where its principal junction with the adjacent nerves takes place.
- c* Ganglionic portion of the pneumo-gastric trunk.
- d* Ganglionless portion.
- e* Ganglion.
- f* Pneumo-gastric trunk below the ganglion; shewing the re-union of the two sets of fibres; viz. those proceeding from the ganglion, and the ganglionless portion.
- g* The superior laryngeal branch arising from the ganglion.

*Fig. 6.*—Pneumo-gastric trunk of the ass detached, as it leaves the base of the scull, and unravelled. (The letters refer to the same parts as in *Fig. 5.*)

*Fig. 7.*—The same in the sheep.



Fig. 1.



Fig. 2.

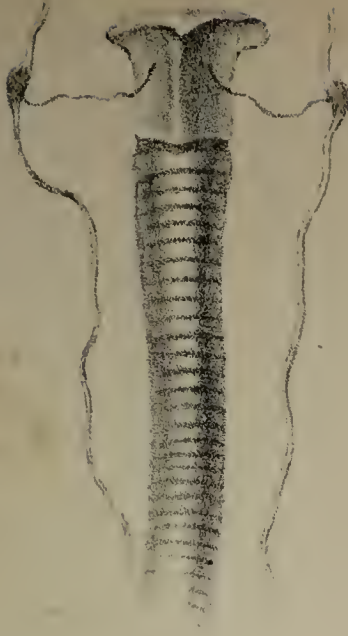


Fig. 3.



Fig. 7.



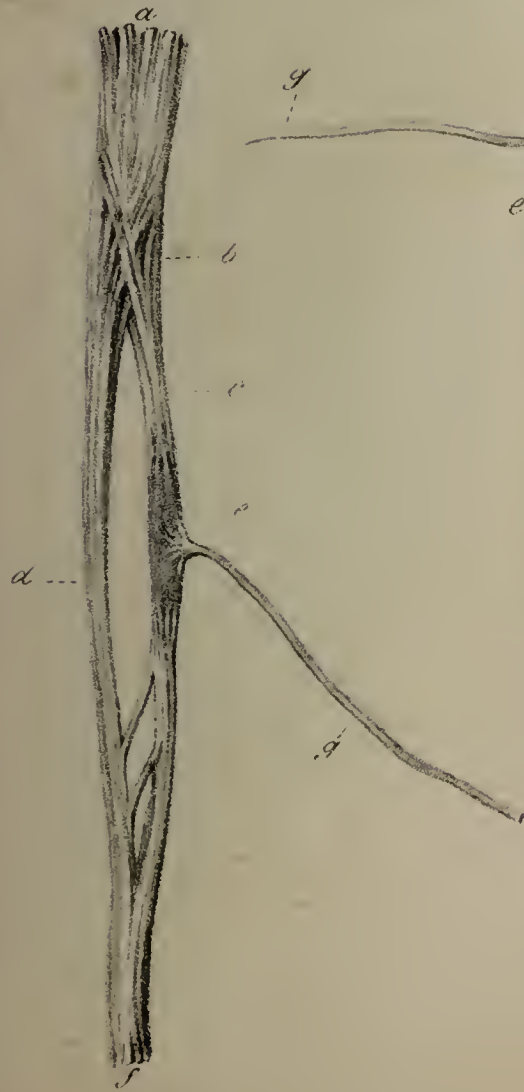
Fig. 6.



Fig. 4.



Fig. 5.



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